BRITISH STANDARD

BS EN 14023:2010

Bitumen and bituminous binders — Specification framework for polymer modified bitumens

ICS 93.080.20

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 14023:2010. It supersedes BS EN 14023:2005 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee B/510, Road materials, to Subcommittee B/510/19, Bitumen and related products.

A list of organizations represented on this committee can be obtained on request to its secretary.

This Standard is a revision of BS EN 14023:2005 and incorporates the principle changes outlined below:

- further harmonization of the original standard;
- a subdivision of properties into three groups in the tables;

In the tables, properties are subdivided into three groups as follows:

1. The properties in Table 1 shall be specified for all polymer modified bitumens. They are associated with regulatory or HSE requirements.
2. The properties in Table 2 are required to meet specific regional conditions. They are associated with regulatory or other regional requirements.
3. The properties in Table 3 are additional properties, which are non-mandated, but have been found useful in some countries to describe polymer modified bitumens.

Guidance for users on the implementation of BS EN 14023:2010 for polymer modified bitumens for use in the construction and maintenance of roads and airfields in the UK is included in National Annex NA (informative).

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2010

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Bitumen and bituminous binders - Specification framework for polymer modified bitumens

Bitumes et liants bitumineux - Cadre de spécifications des bitumes modifiés par des polymères

Bitumen und bitumenhaltige Bindemittel - Rahmenwerk für die Spezifikation von polymermodifizierten Bitumen

This European Standard was approved by CEN on 6 March 2010.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

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Foreword

This document (EN 14023:2010) has been prepared by Technical Committee CEN/TC 336 “Bituminous binders”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2010, and conflicting national standards shall be withdrawn at the latest by October 2010.

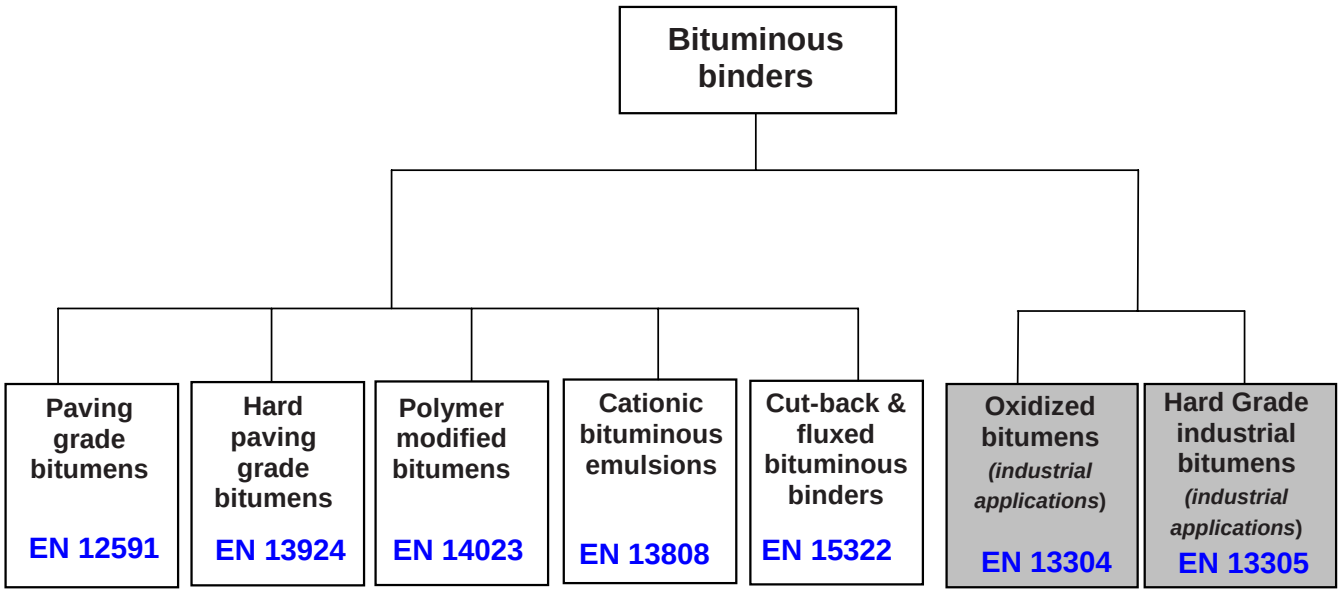
Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14023:2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European Standard is part of a family of European Standards for bitumen as follows:



NOTE Industrial applications are not covered by mandate M/124.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard is closely related to EN 12591, *Bitumen and bituminous binders – Specifications for paving grade bitumens* [1]. This introduction gives information on the basis for selection of the grades defined in this European Standard, the status of certain characteristics and test methods, and proposed development of this European Standard.

The general principle adopted in the development of EN 12591 [1] was to provide a range of grades suitable for the manufacture of the materials for road construction and maintenance used, and the climatic and traffic conditions encountered, in all the Member States. This European Standard extends the range of grades specified in EN 12591 [1], following the wider use of modified binders for road construction and maintenance having improved performances.

As with EN 12591 [1], it is compulsory for the full specification to be published in all EU and EFTA countries. However, it is permitted for each country to define the most suitable grades and classes.

Annex B lists informative characteristics which producers of polymer modified bitumens are invited to supply to the client on a voluntary basis. It is hoped that the data so gathered will be of assistance in developing performance-related specifications in the future.

1 Scope

This European Standard provides a framework for specifying the characteristics and relevant test methods for polymer modified bitumens which are suitable for use in the construction and maintenance of roads, airfields and other paved areas.

This framework covers the following characteristics:

— "consistency at intermediate service temperature";

— "consistency at elevated service temperature";

— "cohesion";

— "durability" of consistency;

— "brittleness at low service temperature";

— "strain recovery".

The cohesion property has been included as a means of discriminating between polymer modified bitumens and other bituminous binders. The other essential requirements, "adhesion" and "setting ability" are indicated by tests carried out on the finished asphalt mixtures.

The introduction of classes of convenience in Table 1, Table 2 and Table 3 enables the selection of the most suitable specification for the bitumen taking account of local conditions of climate and use. The nomenclature of polymer modified bitumens comprises the penetration range and the minimum softening point (see example in Annex A).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 58, *Bitumen and bituminous binders — Sampling bituminous binders*

EN 1426, *Bitumen and bituminous binders — Determination of needle penetration*

EN 1427, *Bitumen and bituminous binders — Determination of the softening point — Ring and Ball method*

EN 12593, *Bitumen and bituminous binders — Determination of the Fraass breaking point*

EN 12594, *Bitumen and bituminous binders — Preparation of test samples*

EN 12595, *Bitumen and bituminous binders — Determination of kinematic viscosity*

EN 12596, *Bitumen and bituminous binders — Determination of dynamic viscosity by vacuum capillary*

EN 12597:2000, *Bitumen and bituminous binders — Terminology*

EN 12607-1*, Bitumen and bituminous binders — Determination of the resistance to hardening under the influence of heat and air — Part 1: RTFOT method*

EN 13302, *Bitumen and bituminous binders — Determination of dynamic viscosity of bituminous binder using a rotating spindle apparatus*

EN 13398, *Bitumen and bituminous binders — Determination of the elastic recovery of modified bitumen*

EN 13399, *Bitumen and bituminous binders — Determination of storage stability of modified bitumen*

EN 13587, *Bitumen and bituminous binders — Determination of the tensile properties of bituminous binders by the tensile test method*

EN 13588, *Bitumen and bituminous binders — Determination of cohesion of bituminous binders with pendulum test*

EN 13589, *Bitumen and bituminous binders — Determination of the tensile properties of modified bitumen by the force ductility method*

EN 13702-1, *Bitumen and bituminous binders — Determination of dynamic viscosity of modified bitumen — Part 1: Cone and plate method*

EN 13703, *Bitumen and bituminous binders — Determination of deformation energy*

EN 15326, *Bitumen and bituminous binders — Measurement of density and specific gravity — Capilliary-stoppered pyknometer method* (including EN 15326:2007/A1:2009)

EN ISO 2592, *Determination of flash and fire points — Cleveland open cup method (ISO 2592:2000)*

EN ISO 4259, *Petroleum products — Determination and application of precision data in relation to methods of test (ISO 4259:2006)*

EN ISO 9001:2008, *Quality management systems — Requirements (ISO 9001:2008)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12597:2000 apply.

The following abbreviation term is used in the specification tables of this document (see Table 1, Table 2 and Table 3):

TBR for "To Be Reported": this class shall mean that the manufacturer is invited, but not required, to provide information, regarding performance characteristics, with the product.

NOTE The reported values (TBR) are intended to be used for future development of specifications.

NR for "No Requirement" may be used when there are no regulations or other regional requirements for the property in the territory of intended use.

4 Sampling

Samples of bulk products shall be taken as described in EN 58.

Test samples shall be taken from the laboratory samples, and prepared for testing, as described in EN 12594.

5 Requirements and test methods

5.1 General

European product standards cover a large variety of road materials for different applications, to accommodate local traffic loads and climatic conditions. This European Standard therefore also covers a large range of bitumens to facilitate the production and application of the designed paving.

This European Standard is a framework of specifications and classes for properties of polymer modified bitumens which are chosen from Table 1, Table 2 and Table 3.

There is a subdivision of properties into three groups in the tables. The properties in Table 1 shall be specified for all polymer modified bitumens. They are associated with regulatory or HSE requirements. The properties in Table 2 are required to meet specific regional conditions. They are associated with regulatory or other regional requirements. The properties in Table 3 are additional properties, which are non-mandated, but have been found useful in some countries to describe polymer modified bitumens.

5.2 Properties and related test methods

5.2.1 General

The properties of, and the related test methods for polymer modified bitumens shall be selected from the classes given in Table 1 and Table 2. When tested by the methods given in a table, the various grades shall conform to the limits specified in that table.

In Table 3 further properties that have been considered useful for specifications are described.

NOTE 1 Each country will then have a particular selection of specifications, which, if regulated, are covered in Tables 1 and 2 and which, if commonly used by industry, are covered in Table 3. It is useful for each country to publish in a national guidance document for each application, their requirements for polymer modified bitumens from Table 1, Table 2 and Table 3. The appropriate class for each technical requirement or application is selected in turn and the selection of classes should be made from past experience of successful use, on a regional basis, in order to avoid unworkable combinations.

NOTE 2 In order to assist in using the tables, an example has been provided in Annex A.

5.2.2 Consistency at intermediate service temperatures

Consistency at intermediate service temperature for polymer modified bitumens shall comply with the requirements for penetration at 25 °C in Table 1. The grades are designated by the nominal penetration range at 25 °C.

5.2.3 Consistency at elevated service temperatures

Consistency at elevated service temperature for polymer modified bitumens shall comply with the requirements for softening point as indicated in Table 1.

Polymer modified bitumens are supplied for a variety of end uses in various climatic conditions; consequently the specifications include a wide range of softening point values.

NOTE The various softening point limits are included so as not to prevent some traditional methods used to evaluate the suitability of modified bitumens in the different European climatic conditions (for more information refer to national guidance documents).

As the grading system is based on the consistency at intermediate and elevated service temperatures, values shall be given for these characteristics.

5.2.4 Brittleness at low service temperature

Brittleness at low service temperature may be required to meet specific regional conditions. Where required, polymer modified bitumens shall conform to the requirements for Fraass breaking point in Table 2.

For some highly modified polymer modified bitumens, Fraass breaking point is not a suitable low temperature method and, in that case, low temperature elastic recovery at 10 °C shall be used.

5.2.5 Cohesion

The property of cohesion is included as a means of differentiating polymer modified bitumens from paving grade bitumens. Three different test methods are included in Table 1: force ductility, tensile test and Vialit pendulum. These reflect the different characteristics that can occur with polymer modified bitumens and are not considered to be equivalent. It is intended that the most appropriate cohesion test method shall be used in each case, at the discretion of the supplier. The manufacturer shall state the test method used.

One cohesion method shall be chosen based on end application. Vialit cohesion (EN 13588) shall only be used for surface dressing binders.

5.2.6 Durability – Resistance to hardening

Resistance to hardening shall be tested after conditioning in accordance with the Rolling Thin Film Oven Test (RTFOT) (see EN 12607-1).

The main test is the RTFOT at 163 °C. For some highly viscous polymer modified bitumens where the viscosity is too high to provide a moving film it is not possible to carry out the RTFOT at the reference temperature of 163 °C. In such cases the procedure shall be carried out at 180 °C in accordance with EN 12607-1.

NOTE In order to assist in controlling rutting deformation and cracking of asphalt mixes, optional tests and classes, for measurements on material after the hardening procedure, are given in Table 3. The choice will depend upon climatic conditions, traffic and local use.

Resistance to hardening is not appropriate for surface dressing bitumens.

5.2.7 Strain recovery

Strain recovery may be required to meet specific regional conditions. Where required, polymer modified bitumens shall conform to the requirements for elastic recovery at 25 °C or 10 °C in Table 2.

5.2.8 Other properties

5.2.8.1 Informative characteristics

The framework specifications include a table of informative characteristics (see Annex B) based on new test methods that are under validation. Producers of polymer modified bitumens are invited to supply data from these measurements to the client on a voluntary basis. It is hoped that the data so gathered will be of assistance in developing performance-related specifications in the future.

5.2.8.2 Flash point

The flash point shall be determined by the Cleveland open cup method in EN ISO 2592 for normal specification purposes.

NOTE The Pensky-Martens closed cup method (see EN ISO 2719 [6]) can be used to investigate possible contamination but is likely to give lower values.

5.2.8.3 Density

Where required, density shall be determined in accordance with EN 15326.

5.2.8.4 Plasticity range

The plasticity range is the numerical difference between the softening point and Fraass breaking point.

EXAMPLE Polymer modified bitumen with a softening point of 75 °C and a Fraass breaking point of - 18 °C would have a plasticity range of 93 °C.

5.2.8.5 Storage conditions

Storage conditions of the polymer modified bitumen shall be given by the supplier.

5.2.8.6 Homogeneity and storage stability

Homogeneity is necessary for polymer modified bitumens. The tendency of polymer modified bitumens to separate during storage may be assessed by the storage stability test (see EN 13399). If the product does not fulfil the

properties in Table 3 Class 2 to Class 5, information shall be given by the supplier regarding storage conditions for the polymer modified bitumen to avoid separation of the components and to ensure the homogeneity of the product.

5.3 Release of regulated dangerous substances

Materials used in products shall not release any dangerous substances in excess of the maximum permitted levels specified in a relevant European Standard for the material or permitted in the national regulations of the Member State of destination.

5.4 Precision and dispute

The test methods referred to in this document include precision statements where available. In cases of dispute, the procedures described in EN ISO 4259 for resolving the dispute, and interpretation of the results based on test method precision shall be used.

Table 1 — Framework specifications for polymer modified bitumens – Properties applying to all polymer modified bitumens

PROPERTY		TEST METHOD	UNIT	Classes for all polymer modified bitumens									
				2	3	4	5	6	7	8	9	10	11
Penetration at 25 °C		EN 1426	0,1 mm	10-40	25-55	45-80	40-100	65-105	75-130	90-150	120-200	200-300	
Softening Point		EN 1427	°C	≥ 80	≥ 75	≥ 70	≥ 65	≥ 60	≥ 55	≥ 50	≥ 45	≥ 40	
Cohesion [a]	Force ductility [a] (50 mm/min traction) or	EN 13589 followed by EN 13703	J/cm^2	≥ 3 at 5 °C	≥ 2 at 5 °C	≥ 1 at 5 °C	≥ 2 at 0 °C	≥ 2 at 10 °C	≥ 3 at 10 °C	≥ 0,5 at 15 °C	≥ 2 at 15 °C	≥ 0,5 at 20 °C	≥ 0,5 at 25 °C
	Tensile test [a] (100 mm/min traction) or	EN 13587 followed by EN 13703	J/cm^2	≥ 3 at 5°C	≥ 2 at 5 °C	≥ 1 at 5 °C	≥ 3 at 0 °C	≥ 3 at 10 °C					
	Vialit pendulum [a] (Impact test)	EN 13588	J/cm^2	≥ 0,7									
Resistance to hardening [b]	Retained Penetration	EN 12607-1	%	≥ 35	≥ 40	≥ 45	≥ 50	≥ 55	≥ 60				
	Increase in Softening point		°C	≤ 8	≤ 10	≤ 12							
	Change of mass [c]		%	≤ 0,3	≤ 0,5	≤ 0,8	≤ 1,0						
Flash Point		EN ISO 2592	°C	≥ 250	≥ 235	≥ 220							

[a] One cohesion method shall be chosen based on end application. Vialit cohesion (EN 13588) shall only be used for surface dressing binders.

[b] The main test is the RTFOT at 163 °C. For some highly viscous polymer modified bitumens where the viscosity is too high to provide a moving film it is not possible to carry out the RTFOT at the reference temperature of 163 °C. In such cases the procedure shall be carried out at 180 °C in accordance with EN 12607-1.

[c] Change of mass can be positive or negative.

The properties in Table 1 shall be specified for all polymer modified bitumens listed in this table. They are associated with regulatory or HSE requirements and shall be included in all specifications.

Table 2 — Framework specifications for polymer modified bitumens – Properties associated with regulatory or other regional requirements

PROPERTY		TEST METHOD	UNIT	Classes for regional requirements										
				0	1	2	3	4	5	6	7	8	9	10
Fraass Breaking Point		EN 12593	°C	NR [a]	TBR [b]	≤ 0	≤ - 5	≤ - 7	≤ - 10	≤ - 12	≤ - 15	≤ - 18	≤ - 20	≤ - 22
Elastic recovery	25 °C or [c]	EN 13398	%	NR [a]	TBR [b]	≥ 80	≥ 70	≥ 60	≥ 50					
	10 °C	EN 13398	%	NR [a]	TBR [b]	≥ 75	≥ 50							

[a] NR. No Requirement may be used when there are no regulations or other regional requirements for the property in the territory of intended use.

[b] TBR. To Be Reported may be used when there are no regulations or other regional requirements for the property in the territory of intended use, but the property has been found useful to describe polymer modified bitumens.

[c] Where required, polymer modified bitumens shall conform to the requirements for elastic recovery at 25 °C or 10 °C.

The properties in Table 2 are required to meet specific regional conditions. They are associated with regulatory or other regional requirements.

Table 3 — Framework specifications for polymer modified bitumens – Additional properties

PROPERTY	TEST METHOD	UNIT	Classes for the additional properties of polymer modified bitumens							
			0	1	2	3	4	5	6	7
Plasticity range	5.2.8.4	°C	NR [a]	TBR	≥ 85	≥ 80	≥ 75	≥ 70	≥ 65	≥ 60
Drop in softening point after EN 12607-1	EN 1427	°C	NR [a]	TBR	≤ 2	≤ 5				
Elastic recovery at 25 °C after EN 12607-1	EN 13398	%	NR [a]	TBR	≥ 70	≥ 60	≥ 50			
Elastic recovery at 10 °C after EN 12607-1	EN 13398	%	NR [a]	TBR	≥ 50					
Storage stability [b] Difference in softening point	EN 13399 EN 1427	°C	NR [a]	TBR [b]	≤ 5					
Storage stability [b] Difference in penetration	EN 13399 EN 1426	0,1 mm	NR [a]	TBR [b]	≤ 9	≤ 13	≤ 19	≤ 26		

[a] NR. No Requirement may be used when there are no requirements for the property in the territory of intended use.

[b] Storage conditions of the polymer modified binder shall be given by the supplier. Homogeneity is necessary for polymer modified bitumens. The tendency of polymer modified bitumens to separate during storage may be assessed by the storage stability test (see EN 13399). If the product does not fulfil the properties in Table 3 Classes 2 to 5, information shall be given by the supplier regarding storage conditions for the polymer modified bitumen to avoid separation of the components and to ensure the homogeneity of the product.

NOTE The following data may be given by the supplier of the polymer modified bitumen in the product data sheet:
- polymer dispersion (see EN 13632 [5]);
- solubility (see EN 12592 [4] using the appropriate solvent declared by the supplier);
- handling temperatures;
- minimum storage and pumping temperatures;
- maximum and minimum mixing temperatures; for comparison purposes, EN 13302 or EN 13702-1 should be used;
- density (see EN 15326).

The properties in Table 3 are additional properties, which are non-mandated, but have been found useful in some countries to describe polymer modified bitumens.

6 Evaluation of conformity

6.1 General

The compliance of polymer modified bitumens with the requirements of this document and with the stated values (including classes) shall be demonstrated by:

— Initial Type Testing (ITT);

— Factory Production Control (FPC).

NOTE The information from evaluation of conformity can be available for audit as detailed in the manufacturer's Quality Plan.

6.2 Type testing

6.2.1 Initial type testing (ITT)

Initial type tests shall be performed to show conformity of the polymer modified bitumen with this European Standard. Tests previously performed in accordance with the provisions of this European Standard (same product, same characteristic(s), test method, sampling procedure, system of attestation of conformity, etc.) may be taken into account.

All the characteristics required in the European Standard shall be subject to Initial Type Testing (ITT) except dangerous substances, which may be declared by control of the base materials, and characteristics where NR is chosen.

6.2.2 Further type testing

Whenever a change occurs in the base materials or the production process which would change significantly one or more of the characteristics, the type test shall be repeated for the appropriate characteristic(s).

6.2.3 Sampling, testing and compliance criteria

Samples shall be taken as specified in Clause 4.

The results of all type tests (initial and further type tests) shall be recorded, held by the manufacturer for at least five years from the date of the test and be available for inspection.

6.3 Factory Production control (FPC)

6.3.1 General

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market conform to the stated characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control the quality of the finished product.

An FPC system conforming to the requirements of EN ISO 9001:2008 and made specific to the requirements of this standard shall be deemed to satisfy the above requirements.

The results of inspections, tests or assessments requiring action shall be recorded, as shall any action taken. The action to be taken when control values or criteria are not met shall be recorded and retained for the period specified in the manufacturer's FPC procedures.

6.3.2 Equipment

In accordance with testing, all weighing, measuring and testing equipment shall be calibrated and regularly inspected according to documented procedures, frequencies and criteria.

In accordance with manufacturing, all equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process. Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures on equipment identified by the manufacturer as necessary to achieve or maintain product quality and the records retained for the period defined in the manufacturer's FPC procedures.

6.3.3 Base materials and components

The acceptance criteria for all base materials and components shall be as detailed in the quality plan as shall the inspection scheme for ensuring their conformity. When base materials and components from external suppliers are not CE marked, the inspection scheme detailed in Table 4 should be used as a minimum requirement.

Table 4 — Inspection scheme for base materials and components

<table>
<tr><th>Material/component</th><th>Control</th><th>Method</th><th>Frequency</th></tr>
<tr><td rowspan="4">Base bitumen or
Concentrated mixture or
Mother solution</td><td>Conformity with supplier's declaration</td><td>Document examination</td><td>Each delivery</td></tr>
<tr><td rowspan="3">Consistency at intermediate service temperature

or

Consistency at elevated service temperature

or

Viscosity</td><td>EN 1426</td><td>1/grade/supplier/300 t;
minimum 2/week</td></tr>
<tr><td>EN 1427</td><td>1/grade/supplier/300 t;
minimum 2/week</td></tr>
<tr><td>EN 12595 or
EN 12596 or
EN 13302 or
EN 13702-1</td><td>1/grade/supplier/300 t;
minimum 2/week</td></tr>
<tr><td rowspan="2">Polymer(s) and other additives</td><td rowspan="2">Conformity with supplier's declaration</td><td>Document examination</td><td>Each delivery</td></tr>
<tr><td>Organoleptic check</td><td>Each delivery</td></tr>
</table>

NOTE Organoleptic checks may be omitted where the manufacturer has identified any potential Health, Safety or Environmental concerns in carrying out such checks.

6.3.4 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the stated values of all the characteristics are maintained. The characteristics and the means of control are:

a) all characteristics shall be subject to the tests in type testing paragraph (see 6.2) at a minimum frequency of once per year;

b) routine control of product quality shall be on a basis of checks, of a type and a frequency to be defined and documented, to ensure that characteristics do not change significantly from those subject to initial type testing.

The tests for consistency at intermediate and elevated service temperatures, cohesion, durability, brittleness at low service temperature and strain recovery shall be carried out on a representative sample of product for supply to customers.

Where batch production is carried out, the sample should be taken from the batch, which is considered as the quantity of bitumen produced and stored in one tank once the production run into tank has been completed. The batch is considered to remain the same as long as no new production has been added.

In the case of continuous production through an in-line blender, the routine quality control may be carried out on the feeder tanks and a procedure for checking the performance of the blender shall be in place.

In the case of individual production runs of small quantities, the routine quality control may be carried out on a production sample of the product at the minimum frequency.

The appropriate testing frequencies vary with individual facilities, throughput and processes. Minimum frequencies shall be:

c) consistency at intermediate temperature: once per completed batch; or for continuous production or for individual production runs, every 200 t or monthly whilst producing, whichever is more frequent;

d) consistency at elevated service temperature: once per completed batch; or for continuous production or for individual production runs, every 200 t or monthly whilst producing, whichever is more frequent;

e) cohesion, durability: annually;

f) brittleness at low service temperature, strain recovery if required: annually.

6.3.5 Traceability and marking

Individual product batches shall be identifiable and traceable with regard to their production origin. The manufacturer shall have written procedures ensuring that processes related to affixing traceability information and/or markings are inspected regularly. Compliance with EN ISO 9001:2008, 7.5.3 shall be deemed to satisfy the requirements of this subclause.

6.3.6 Non-conforming products

The manufacturer shall have written procedures which specify how non-conforming products shall be dealt with. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures. Compliance with EN ISO 9001:2008, 8.3 shall be deemed to satisfy the requirements of this subclause.

6.3.7 Corrective action

The manufacturer shall have documented procedures that instigate action to eliminate the cause of nonconformities in order to prevent recurrence. Compliance with EN ISO 9001:2008, 8.5.2 shall be deemed to satisfy the requirements of this subclause.

6.3.8 Handling, storage and packaging

The manufacturer shall have procedures to ensure homogeneity of the product and to prevent any damage or deterioration of the polymer modified bitumen.

Annex A
(informative)

Example of selected classes for a PMB 45/80-60

CHARACTERISTIC	PROPERTY	TEST METHOD	UNIT	SELECTED CLASS
Consistency at intermediate service temperature	Penetration at 25 °C	EN 1426	0,1 mm	45-80 (Class 4)
Consistency at elevated service temperature	Softening point	EN 1427	°C	≥ 60 (Class 6)
Cohesion	Force ductility (50 mm/min traction) or	EN 13589 followed by EN 13703	J/cm^2	≥ 2 (Class 3)
	Tensile test (100 mm/min traction) or	EN 13587 followed by EN 13703	J/cm^2	-
	Vialit pendulum (Impact test)	EN 13588	J/cm^2	-
Durability (Resistance to hardening, EN 12607-1)	Change of mass	EN 12607-1	%	≤ 0,5 (Class 3)
	Retained penetration	EN 1426	%	≥ 50 (Class 5)
	Increase in softening point	EN 1427	°C	≤ 8 (Class 2)
Brittleness at low service temperature	Fraass breaking point	EN 12593	°C	≤ - 10 (Class 5)
	Elastic recovery at 10 °C	EN 13398	%	NR (Class 0)
Strain recovery	Elastic recovery at 25 °C	EN 13398	%	≥ 50 (Class 5)
	Elastic recovery at 10 °C	EN 13398	%	NR (Class 0)
Additional characteristics	Flash Point	EN ISO 2592	°C	≥ 235 (Class 3)
	Plasticity range	5.1.9	°C	TBR (Class 1)
	Storage stability Difference in softening point	EN 13399 EN 1427	°C	≤ 5 (Class 2)
	Storage stability Difference in penetration	EN 13399 EN 1426	0,1 mm	TBR (Class 1)
	Drop in softening point after EN 12607-1	EN 1427	°C	NR (Class 0)
	Elastic recovery at 25 °C after EN 12607-1	EN 13398	%	≥ 50 (Class 4)
	Elastic recovery at 10 °C after EN 12607-1	EN 13398	%	NR (Class 0)

Annex B
(informative)

Other properties

The test methods in this document represent the current knowledge of the industry. On a voluntary basis some countries are evaluating other test methods to gain experience for further developments. For example the following methods are under validation:

— Bending Beam Rheometer based on test method EN 14771 [3];

— Dynamic Shear Rheometer based on test method EN 14770 [2];

— Deformation Energy by Force Ductility based on test methods EN 13589 and EN 13703 under different test conditions.

The test condition should be selected according to traffic and climatic conditions or in relation to the grades to be applied, e.g. for this can be:

— Bending Beam Rheometer: Stiffness values at - 16 °C;

— Dynamic Shear Rheometer: Complex modulus and phase angle at 60 °C;

— Deformation Energy at different temperatures in relation to the grades to be applied.

Annex ZA
(informative)

Clauses of this European Standard addressing the provisions of the EU Construction Products Directive

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under Mandate M/124 "Road Construction Products" given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard shown in this annex meet the requirements of the Mandate given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the polymer modified bitumens covered by this annex for the intended uses indicated herein; reference shall be made to the information accompanying the CE marking.

WARNING — Other requirements and other EU Directives, not affecting the fitness for intended uses, can be applicable to the paving grade bitumen falling within the scope of this European Standard.

NOTE 1 In addition to any specific clauses relating to dangerous substances contained in this standard, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA, (accessed through http://ec.europa.eu/enterprise/construction/internal/dangsub/dangmain_en.htm).

This annex establishes the conditions for the CE marking of the polymer modified bitumens intended for the uses indicated in Table ZA.1 and shows the relevant clauses applicable.

This annex has the same scope as Clause 1 of this standard and is defined by Table ZA.1.

Table ZA.1 — Relevant clauses for polymer modified bitumens from Tables 1 and 2

Construction Product(s): polymer modified bitumens Intended use(s): For construction and maintenance of roads, airfields and other paved areas (graded by penetrability)			
Requirement/ Characteristic from the Mandate:	**Requirement clause(s) in this or other European Standard(s)**	**Mandated level(s) and/or class(es)**	**Notes**
Consistency at intermediate service temperature	5.2.2	None	Class
Consistency at elevated service temperature	5.2.3	None	Class
Cohesion	5.2.5	None	Class
Durability of the consistency at intermediate and elevated service temperatures	5.2.6	None	Classes
Brittleness at low service temperature	5.2.4	None	Class NPD may be used
Strain recovery	5.2.7	None	Class NPD may be used
Regulated dangerous substances	5.3	None	See ZA.1, Note 2

The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements on that characteristic for the intended use of the product. In this case, manufacturers placing their products on the market of these MSs are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option "No performance determined" (NPD) in the information accompanying the CE marking (see ZA.3) may be used.

ZA.2 Procedure for attestation of conformity of polymer modified bitumens

ZA.2.1 System of attestation of conformity

The system of attestation of conformity of polymer modified bitumens indicated in Table ZA.1, in accordance with the Decision of the Commission 98/601/EC of 13 October 1998 (published as doc. L287 on 24 October

1998) amended by the Commission decision 01/596/EC of 8 January 2001 (published as doc. L209 the 2 August 2001) and as given in Annex III of the Mandate M/124 are shown in Table ZA.2 for the indicated intended use and relevant levels or classes.

Table ZA.2 — System of attestation of conformity for polymer modified bitumen

Product	Intended use	Level(s) or class(es)	Attestation of conformity system
Family: Bitumen Sub-family: polymer modified bitumen	For road construction and surface treatment of roads	None	2+
System 2+: See Directive 89/106/EEC (CPD) Annex III.2.(ii), First possibility, including certification of the factory production control by an approved body on the basis of initial inspection of factory and of factory production control as well as of continuous surveillance, assessment and approval of factory production control.			

The attestation of conformity of polymer modified bitumens in Table ZA.1 shall be according to the evaluation of conformity procedures indicated in Table ZA.3 resulting from application of the clauses of this European Standard indicated therein.

Table ZA.3 — Assignment of evaluation of conformity tasks

Tasks			Content of the task	Evaluation of conformity clauses to apply
Tasks under the responsibility of the manufacturer	Factory production control (FPC)		Parameters related to all relevant characteristics of Table ZA.1	6.3
	Initial type testing (ITT)		All relevant characteristics of Table ZA.1	6.2.1
	Certification of FPC by a notified body on the basis of:	Initial inspection of factory and of FPC	Parameters related to all relevant characteristics of Table ZA.1, i.e.: — *consistency at intermediate service temperature;* — *consistency at elevated service temperature;* — *brittleness at low service temperature;* — *cohesion;* — *durability of consistency at intermediate service temperature;* — *durability of consistency at elevated service temperature;* — *strain recovery.*	6.3
		Continuous surveillance, assessment and approval of FPC	Parameters related to all relevant characteristics of Table ZA.1, i.e.: — *consistency at intermediate service temperature;* — *consistency at elevated service temperature;* — *brittleness at low service temperature;* — *cohesion;* — *durability of consistency at intermediate service temperature;* — *durability of consistency at elevated service temperature;* — *strain recovery.*	6.3

ZA.2.2 EC Certificate and Declaration of conformity

When compliance with the conditions of this annex is achieved, and once the notified body has drawn up the certificate mentioned below, the manufacturer or his agent established in the EEA (European Economic Area)

shall draw up and retain a declaration of conformity, which entitles the manufacturer to affix the CE marking. This declaration shall include:

— name and address of the manufacturer, or his authorised representative established in the EEA, and the place of production;

NOTE 1 The manufacturer may also be the person responsible for placing the product onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use, etc.) and a copy of the information accompanying the CE marking;

NOTE 2 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

— provisions to which the product conforms (i.e. Annex ZA of this EN);

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions);

— the number of the accompanying factory production control certificate, and FPC records, where applicable;

— name of, and position held by, the person empowered the declaration on behalf the manufacturer or his authorized representative.

The declaration shall be accompanied by a factory production control certificate, drawn up by the notified body, which shall contain, in addition to the information above, the following:

— name and address of the notified body;

— the number of the factory production control certificate;

— conditions of validity of the certificate, where applicable;

— name of, and position held by, the person empowered to sign the certificate.

The above mentioned declaration and certificate shall be presented in the language or languages accepted in the Member State in which the product is to be used.

ZA.3 CE Marking and labelling

The manufacturer or his authorized representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EEC and shall be shown on the relevant commercial documents or on the packaging where possible. The following information shall accompany the CE marking symbol together with the relevant test method against the characteristic if more than one test method is available under this standard:

a) identification number of the certification body;

b) name or identifying mark and registered address of the manufacturer (see Note 1 in ZA.2.2);

c) the last two digits of the year in which the marking is affixed;

d) number of the EC Certificate of conformity or factory production control certificate (if relevant);

e) reference to this European Standard (EN 14023);

f) description of the product: generic name and grade and intended use;

g) information on those relevant essential characteristics listed in Table ZA.1 which are to be declared presented as follows:

   1) declared values, and where relevant, level or class to declare for each essential characteristic as indicated in "Notes" in Table ZA.1;

   2) "No performance determined" for characteristics where this is relevant.

The "No performance determined" (NPD) option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements in the Member State of destination.

Figure ZA.1 gives an example of a shortened CE marking for a delivery note.

Other information on the characteristics listed in Tables ZA 1 shall be made available with the accompanying document(s).

Figure ZA.2 and Figure ZA.3 give examples of the information to be given on the commercial documents.

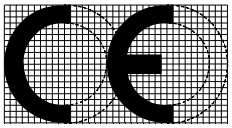
 **01234**	*CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.* *Identification number of the notified body*
AnyCo Ltd, P.O. Box 21, B - 1050 **10** 01234-CPD-00234	*Name or identifying mark and registered address of the producer* *Last two digits of the year in which the CE marking was affixed* *Certificate number*
EN 14023 *Polymer modified bitumen 45/80-60*	*Reference to the European Standard* *Description of product and information on regulated characteristics*

Figure ZA.1 — Example of shortened CE marking for delivery note

CE	*CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.*
01234	*Identification number of the notified body*
AnyCo Ltd, P.O. Box 21, B - 1050	*Name or identifying mark and registered address of the producer*
10	*Last two digits of the year in which the CE marking was affixed*
01234-CPD-00234	*Certificate number*
EN 14023	*Reference to the European Standard*
Polymer modified bitumen 45/80-60	*Description of product and information on regulated characteristics*
Penetration at 25 °C……Class 4 **Softening point……....Class 6** **Force ductility…….. Class 3** **Resistance to hardening (EN 12607-1)** **. Retained penetration at 25 °C……Class 5** **. Increase in softening point……..Class 2**	

Figure ZA.2 — Example of CE marking information

CE	*CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.*
01234	*Identification number of the notified body*
AnyCo Ltd, P.O. Box 21, B - 1050 **10** 01234-CPD-00234	*Name or identifying mark and registered address of the producer* *Last two digits of the year in which the CE marking was affixed* *Certificate number*
EN 14023 *Polymer modified bitumen 45/80-60* **Penetration at 25 °C…….. 45-80** **Softening point……. ≥ 60 °C** **Force ductility……. ≥ 2 at 5 °C** **Resistance to hardening (EN 12607-1)** **. Retained penetration at 25 °C…….. ≥ 50 %** **. Increase in softening point…….. ≤ 8 °C** **Fraass breaking point……. ≤ - 10 °C** **Elastic recovery at 25 °C ……. ≥ 50 %** **Elastic recovery at 10 °C ……. NPD**	*Reference to the European Standard* *Description of product and information on regulated characteristics*

Figure ZA.3 — Example of CE marking information and classes with associated regulatory regional requirements

In addition to any specific information relating to dangerous substances shown above, the product should also be accompanied, if required by appropriate documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

NOTE 1 European legislation without national derogations need not be mentioned.

NOTE 2 Affixing CE marking symbol means, if a product is subject to more than one directive, that it complies with all applicable directives.

Bibliography

[1] EN 12591, *Bitumen and bituminous binders — Specifications for paving grade bitumens*

[2] EN 14770, *Bitumen and bituminous binders — Determination of complex shear modulus and phase angle — Dynamic Shear Rheometer (DSR)*

[3] EN 14771, *Bitumen and bituminous binders — Determination of the flexural creep stiffness — Bending Beam Rheometer (BBR)*

[4] EN 12592, *Bitumen and bituminous binders — Determination of solubility*

[5] EN 13632, *Bitumen and bituminous binders — Visualisation of polymer dispersion in polymer modified bitumen*

[6] EN ISO 2719, *Determination of flash point — Pensky-Martens closed cup method (ISO 2719:2002)*

National Annex NA (informative**)**
Guidance for the use of BS EN 14023 in the UK

Introduction

This National Annex NA (informative) provides guidance to manufacturers, users, suppliers and specifiers on the implementation of BS EN 14023:2010, *Bitumen and bituminous binders – Specification framework for polymer modified bitumens*, for use in products for the construction and maintenance of roads and airfields in the UK.

BS EN 14023:2010 is not a performance-related specification but contains a framework of 'classes' for various empirical properties, which enable polymer modified bitumens (PMB) to be categorized in a systematic, harmonized way. In theory, any sensible combination of classes in Tables 1, 2 and 3 may be selected, however, without guidance the use of BS EN 14023:2010 may cause confusion. It is important to note that the classes are not necessarily relevant to all types of PMBs, or to performance in some applications, and would not necessarily provide enhanced performance in specific applications.

In the UK the vast majority of PMBs are proprietary binders, which have been developed with specific applications in mind using the PMB supplier's chosen technology(ies) to enhance performance. Asphalt/emulsion/cut-back/bond coat manufacturers have selected a particular PMB in order to achieve the required end-performance of their product in the most cost-effective manner.

The great majority of products in the UK that use PMBs have traditionally demonstrated performance enhancement via a product approval scheme, such as the Highways Authorities Product Approval Scheme (HAPAS), or by conformance with performance-related specifications, for example, the Specification for Highway Works (SHW) or by a history of successful use. These practices have served the UK industry successfully for many years and it is expected that they will continue to for products containing PMB, supplemented by the introduction and use of European performance-related specifications for the end products.

If conventional, empirical characteristics for PMBs are specified without assessment of the final product performance, there is the possibility that the product containing the PMB will not perform satisfactorily and/or be cost-effective.

In the UK, it is therefore recommended that the classification of PMBs in accordance with this Standard, and their properties required to meet the performance requirements of the resulting asphalts, surface dressing binders or bond coats, continue to be agreed between the PMB supplier and the asphalt/emulsion/cut-back/bond coat manufacturer.

NA.1 Implementation

BS EN 14023:2010 is principally applicable to PMBs used in hot mix asphalt and to PMBs used to produce bitumen emulsions, or cut-back/fluxed bitumens for use in cold/warm mix asphalt, surface dressing binders and bond coats.

In the UK, polymer modified grade bitumens have previously been specified to BS EN 14023:2005, which has been superseded by this Standard.

A suggested specification clause that a Client, e.g. a highway authority, could use in a contract is as follows:

'Polymer modified bitumens shall conform to the requirements of BS EN 14023:2010 and National Annex NA (informative).'

The system for nomenclature of PMBs remains unchanged from the previous version of the Standard, i.e. the penetration range and minimum softening point is used; for example, a PMB with a penetration range of 45 to 80 (class 4) and a minimum softening point of 60ºC (class 6) would be described as a PMB 45/80-60.

NOTE It is possible for a supplier to have two different PMBs with the same penetration range and softening point class for different applications and with different performance. It should therefore be noted that brand names for proprietary PMBs will continue to be used. However, for regulatory and CE marking purposes, PMB suppliers should also state the nomenclature for their binders in accordance with BS EN 14023:2010 on the relevant technical information and delivery documentation.

NA.2 National guidance for the selection of properties regarding Tables 1, 2 and 3

In accordance with Subclause 5.2.1 Note 1 in this Standard, the UK committee provides the following National requirements for PMBs for use in products for the construction and maintenance of roads and airfields:

The PMB supplier shall state for each PMB the class for each of the properties shown in Tables 1, 2 and 3. The information should appear on the technical information documentation provided by the PMB supplier. For Tables 1 and 2 this information is needed for CE marking purposes, for Table 3 it is not.

For Tables 1 and 2:

- Only one test method should be chosen by the PMB supplier for the cohesion property in Table 1.
- Class 0 (NR, i.e. No Requirement) or class 1 (TBR, i.e. To Be Reported) may be selected by the PMB supplier in Table 2.
- The PMB supplier should state the temperature at which the RTFOT is carried out for each PMB. It should be noted that it is not valid to compare the properties of different PMBs if the RTFOT is carried out at different temperatures.

For Table 3:

- Class 0 (NR, i.e. No Requirement) or class 1 (TBR, i.e. To Be Reported) may be selected by the PMB supplier in Table 3.

Annex B (informative); Other properties

Annex B of BS EN 14023:2010 refers to ‘other properties’, which are additional characteristics, determined using new test methods that are being used on a voluntary basis by some countries to gain experience for further developments, for example, for use in performance related PMB specifications in the future.

The ‘other properties’ are not yet ready to be used in specifications. The performance of the end product is unlikely to be determined by the binder properties specified in Tables 1, 2 and 3 alone, but these ‘other properties’ could be used for binder selection purposes by the asphalt/emulsion/cut-back/bond coat manufacturer prior to testing of their product.

NA.3 Evaluation of Conformity

Requirements for ‘evaluation of conformity’ detail the steps that PMB manufacturers need to take in order to demonstrate conformity with the specification. These procedures start with ‘type testing’, which details the way conformity with all the requirements is determined, and include ‘factory production control’, which indicates the procedures to be adopted during production to ensure consistent conformity. These procedures need to be followed whether CE marking is being undertaken or not.

NA.3.1 Type Testing

All tests detailed in the specification, with the exception of those where the PMB supplier has chosen Class 0 (NR, i.e. No Requirement), should be carried out as part of the initial evaluation of a PMB; this is called ‘initial type testing’. In addition, whenever the manufacturer makes a change to the base materials or production process, which he expects could make a significant change to one or more of the properties of the PMB, the relevant test(s) should be repeated. If the difference requires a change of class of one or more properties of the PMB, the user should be informed and, where appropriate, the technical information, delivery documentation and CE marking should be amended.

NA.3.2 Factory Production Control (FPC)

PMB manufacturers should operate a quality management scheme that should be in accordance with the FPC requirements in BS EN 14023:2010 and give a schedule for the specific type of quality control system. This may be based on the requirements of existing third party accredited systems, i.e. BS EN ISO 9001, and the requirements of National Highway Sector Scheme 15.

NA.3.3 Attestation of Conformity

Compliance with the requirements in BS EN 14023:2010 for factory production control, initial type testing, ongoing surveillance and accreditation by a notified body will entitle a PMB manufacturer to prepare a declaration of conformity for his PMB(s). This declaration needs to include information about the PMB(s), the manufacturer and quality assurance. The requirements are detailed in the informative Annex ZA of the Standard. The declaration should be available on demand by the user from the PMB supplier.

NA.4 CE Marking

After the declaration of conformity, BS EN 14023:2010 suggests that a PMB supplier is entitled to affix CE marking. Although this will be a requirement – effectively a licence to trade – in most of the EU and European Free Trade Association (EFTA) countries, it is not a legal requirement at the present time in the UK. Examples of CE marking suitable for use in the UK are given in Figures ZA.1, ZA.2 and ZA.3 in Annex ZA of the Standard. According to BS EN 14023:2010, information from the declaration of conformity is required plus the information that is needed to meet EC Mandate M/124.

As it is not practical to physically attach the CE marking (logo) to the binder, it is recommended that it should appear on the CE marking documentation along with the other information required. Figure ZA.1 shows the information that should appear on documents that are given to customers with each delivery (delivery tickets). Figure ZA.3 shows an example of the information that should appear on product information sheets in countries where there are additional regulatory requirements.

The CE marking logo should be as shown in the example in the Standard, but cannot be less than 5mm high. As some of the required information already appears on delivery tickets, the remaining CE marking information can be positioned in any appropriate location so long as it is clearly visible. On product information sheets, it is preferable for all the CE marking information to be in a format similar to that shown in the example.

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